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31. (New) A structural panel as claimed in claim 7 wherein there is a metal sheet surface layer chemically and mechanically bonded to each of the opposed major surfaces of said thermoset cellular urethane body, each of said metal sheet surface layers is generally planar, but is contoured so that there are plural linear discontinuities extending thereacross and there is a pair of closely adjacent, generally parallel legs extending across said surface layer at each discontinuity, one edge of each of said legs being integral with said surface layer on one side of each discontinuity, and the opposed edges of the legs of each of said pairs being integral with one another, said legs extending into the thermoset, cellular urethane body, and the exterior surfaces of each of said pairs of legs being chemically and mechanically bonded to said thermoset urethane.

REMARKS

The election of the invention of Group III, claims 7-11, reported in the May 22 Official action, is hereby affirmed. It is recognized that new claim 24 is directed to a method for producing a structural panel and that claim 26 is directed to the panel produced by the method of claim 24..

The submission herewith of an Application Data Sheet which includes a complete list of applications in respect of which priority under 35 USC Section 120 is claimed, and the foregoing request that this application be amended to recite priority claims under 35 USC Section 120, based on all of the prior applications listed on the Data Sheet, are believed to have cured the priority issue raised in the May 22 Official action. A consistent declaration is also being filed.

Proposed Fig. 34 and corrected sheets of drawings on which Figs. 23 through 28 appear are being submitted herewith. New figure 34 is believed to overcome the objection to the drawing which is stated in paragraph 8 of the Official action. The first complete paragraph on page 44 of the present application, as filed, described a panel with sheet metal facings on its major surfaces. Fig. 34 shows the panel described; the Examiner's approval of the drawing and of the text referring to the drawing are respectfully requested. Corrected sheets on which Figs. 23 through 28 appear are being submitted because the sheets originally filed lacked lead lines which have been added to the corrected sheets. The Examiner's approval for substitution of the corrected drawing sheets for those originally filed is solicited.

Copies of pages 4, 4 a, 20 a, 24, 44, 44 a and 47, 48, 48 a and 49 are attached hereto. Insertion of page 20 a between original pages 20 and 21, and substitution as follows: pages 4 and 4 a, for original page 4, of page 24 for original page 24, of pages 44 and 44 a for original page 44,

and of pages 47, 48, 48 a and 49 for original pages 47-49 will provide clean amended text.

The new abstract submitted above is believed to overcome the objection to the original abstract by providing a concise statement (in fewer than 150 words) of the elected invention; reconsideration and withdrawal of the objection are respectfully requested.

Claims7 and 9, amended as requested above, and new claims 25 and 27-31, all directed to the elected invention, are believed to be patentable over the cited references, "Paakkinen", "Murdock", "MacMillan" and "Huetteman", US patents 4,640,074, 6,085,485, 2,757,116 and 5,095,674, respectively, and over the prior art cited by Paakkinen (column 1, lines 57-68), and by Murdock (column 1, line 31 through column 2, line 6). None of this art discloses a body of a thermoset urethane foam with a metal or other sheet chemically and mechanically bonded to a surface of the foam. Of the art cited by Paakkinen and Murdock, "Glaros", US 3,535,844, is deemed to be exemplary of the most relevant, disclosing a "foamed in situ urethane foam insulant" but not chemical or mechanical bonding of that "insulant" to any other body. Glaros states:

> "In FIGS. 1 through 3 I have illustrated a preferred embodiment of my invention in which two panel forming members 10 and 11 are spaced apart by a foamed in situ urethane foam insulant 12. The two panel forming members 10 and 11have outer faces of different configurations, that of 10 being perfectly flat and planar, while that of 11 is generally planar but has a central valley or trough portion 14 for decorative as well as utilitarian drainage effect. While I have illustrated an outer skin having a trough it will be obvious that the skin may be flat or have any other configuration and that the inner and outer skins may be identical." (paragraph which commences in line 38 of column 2)

The other art cited by Paakkinen (column 1, lines 57-68), and by Murdock (column 1, line 31 through column 2, line 6), all US patents, is deemed to be either cumulative or less relevant. The following patents are cited by Paakkinen and Murdock: "Glaros" (No. 3,469,873, 09-30-1969), "Martin" (No. 4,143,498, 03-13-1979), "Porter" (No. 4,575,981, 03-18-1986), "Finch" (No. 4,546,590, 10-15-1985), "Thompson" (No. 4,283,897, 08-18-1981), "Artzer" (4,297,820, 11-03-1981), "Wang" (No. 4,790,112, `12-13-1988), "Bowersox" (No. 5,228,257, 07-20-1993) and "Hesser" (No. 5,373,678, 12-20-1994).

New claim 24 is directed to a method which **consists essentially of** placing a layer of a plastic concrete which contains cement, water and an aggregate, and is hardenable by hydration,

in contact with a substantially planar mold surface so that it has an exposed surface which is generally opposed to the substantially planar mold surface, and causing a foamable isocyanate composition which is curable to a thermoset, cellular urethane to foam and cure to a thermoset condition while confined so that a portion of the composition is pressed against the surface of the concrete layer which is generally opposed to the substantially planar mold surface. Claim 26 is directed to the structural panel produced by the method of claim 24. None of the art identified above in the preceding paragraph discloses causing a foamable isocyanate composition which is curable to a thermoset, cellular urethane to foam and cure to a thermoset condition while confined so that a portion of the composition is pressed against the surface of a concrete layer. Accordingly, claims 24 and 26 are also believed to be patentable over the art identified in the preceding paragraph, above.

The attention of the Examiner is respectfully directed to "Labrecque", US patent No. 4,010,232, granted March 1, 1977, which includes the following disclosure (column 1, lines 22-55) of the production of a construction panel:

> "The method of making the construction panel includes forming a dry cement mixture by mixing cement, silica and an aggregate with preferably a coloring agent to obtain a concrete of the desired color. Preferably, the cement is a white cement, the silica is of 70-mesh, and the aggregate is expanded mica, such as the heat expanded mica known under the registered trade mark "ZONOLITE", owned by W. R. Grace Co.
>
> "Some of the dry cement mixture is mixed with water to form a wet cement mixture which is spread into a layer in a mold. Some dry cement is thereafter powdered onto the wet cement mixture until a dry blanket is formed onto the latter. As soon as such dry blanket has been obtained, an unset foaming urethane formulation in liquid form is poured onto the dry cement blanket and the mold is closed by a cover. The setting operation is started at room temperature that is some 70° F Fahrenheit, no heating being required. When the foaming urethane formulation has set into a foam urethane layer, the construction panel is removed from the mold to allow the cement mixture to complete its setting into a concrete layer. The urethane formulation upon reacting in the mold, expands and develops heat and pressure whereby the wet cement mixture is heated and the resulting urethane layer is pressed against the cement layer. Water in the wet cement layer migrates into and wets the dry blanket whereby the latter turns into concrete. This water migration takes place in the closed mold where it is helped by the pressure and heat conditions therein. A firm bond is thus produced between the concrete layer and the foam urethane layer. The mold may be vibrated to pack the wet cement mixture into a compact layer before setting."

Amended claims 7 and 9 and new claim 25 are believed to be patentable over Labrecque and the other art to which reference is made above, none of which either discloses or suggests the

claimed structure composed of a metal sheet chemically and mechanically bonded to a thermoset, cellular polyurethane. Labrecque does not disclose a metal sheet or chemical and mechanical bonding, and the other art does not suggest the chemical and mechanical bonding.

The importance of the chemical and mechanical bonding is demonstrated in the instant application, for example in two paragraphs on pages 24 and 25, commencing with the one which bridges the two pages. These paragraphs describe the production of two structures similar to that designated 10 in Fig. 6, differing in both instances in that there was no expanded polystyrene sheet in the structures, and in that aluminum members were used which had the shape of the floor 19, but were extremely thin. Such a thin member was suspended between two supports which extended transversely of its channels, and were separated from one another by twelve inches, and a load was applied in the center of the member. The load caused the member to collapse before available instrumentation indicated the magnitude of the load. In a first case, the procedure described in the paragraph which bridges pages 24 and 25 of the instant application was used to produced the structure, while, in a second, the thin aluminum member was lined with a polyethylene sheet before the isocyanate composition was introduced into the mold. As a consequence, in the first case, a structure according to the instant claims was produced while, in the second, a foamed, thermoset urethane body was produced which fit nicely into, but was not bonded to, the aluminum member. The urethane body, when suspended on supports which were 12 inches apart, failed under a load of 700 pounds, while the aluminum member with the thermoset urethane chemically and mechanically bonded thereto, withstood a load of 4560 pounds before it failed.

New claims 24 and 26 are also believed to be patentable over Labrecque as well as over the other art discussed above. Claim 24, in which the terms "placing" and "plastic" are used in their art recognized meanings (see, for example, *CONCRETE Basics,* a publication of the Portland Cement Association; a copy of this publication is attached hereto) recites a method **consisting essentially of** placing a layer of a plastic concrete which contains cement, water and an aggregate, and is hardenable by hydration, in contact with a substantially planar mold surface so that it has an exposed surface which is generally opposed to the substantially planar mold surface, and causing a foamable isocyanate composition which is curable to a thermoset, cellular urethane to foam and cure to a thermoset condition while confined so that a portion of the composition is pressed against the surface of the concrete layer which is generally opposed to the substantially planar

mold surface. Labrecque, as quoted above, discloses a method which includes an additional step:

> "Some of the dry cement mixture is mixed with water to form a wet cement mixture which is spread into a layer in a mold. Some dry cement is thereafter powdered onto the wet cement mixture until a dry blanket is formed onto the latter. As soon as such dry blanket has been obtained, an unset foaming urethane formulation in liquid form is poured onto the dry cement blanket and the mold is closed by a cover."

The additional step of "powdering" dry cement onto the wet cement mixture until a dry blanket is formed is excluded from the method of claim 24 by the recitation "consisting essentially of".

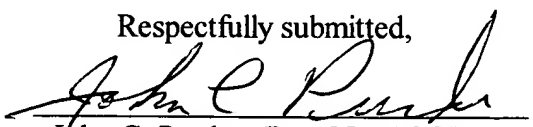
It is noted that the paragraph which bridges pages 24 and 25 of the instant application, in describing the production of a structure according to the instant claims, states that the intermediate/isocyanate composition "expanded to fill the available space inside the mold 14, and cured to such an extent that it could be removed from the mold after about 10 minutes; it had an apparent density of about 20 gm per cc." This is a patent error because it can be calculated that the charge was less than 1 gram per cm^3 of upwardly facing open channels in the aluminum insert in the mold, so that the reported expansion had to be to an apparent density less than 1 gram per cm^3. Since the magnitude of this apparent density is not material, deletion of the erroneous statement has been requested.

New claims 27-31 are all dependent upon claim 7, either directly or remotely. Claims 27-29 are directed to structures of the kinds shown in Figs. 5, and 8-14, while claims 30 and 31 are directed to structures of the kind shown in Fig. 15.

A form PTO/SB/08 is being filed herewith, together with a check in the amount of $180 to pay the fee for late filing of an Information Disclosure Statement. The art cited by the IDS, as explainead above, is the most relevant of that cited by Paakkinen (column 1, lines 57-68), and by Murdock (column 1, line 31 through column 2, line 6) and Labrecque, all discussed above.

Favorable action is solicited.

Respectfully submitted,



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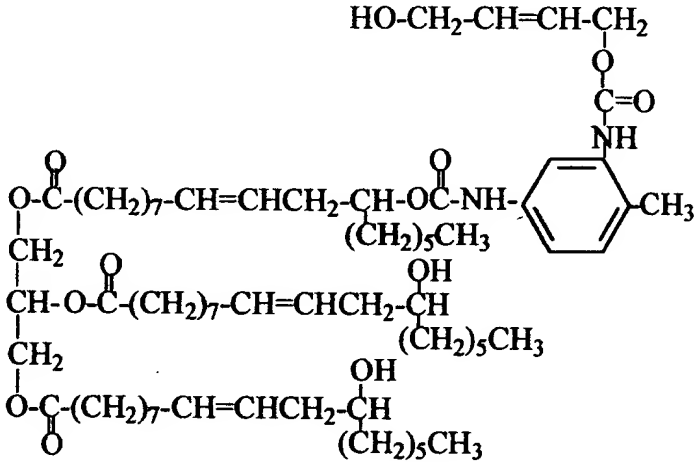
materials in producing Dyligomers, which can also serve as monomers in both polycondensation reactions and in addition propagation reactions. An example of such a Dyligomer, which can be produced by reaction of one molecule of the triglyceride of ricinoleic acid and one molecule of 1,4-but-2-ene diol with one molecule of 2,4-toluene diisocyanate ("TDI"), has the following structure, and is hereinafter called "Dyligomer I":



Dyligomer I

Dyligomer I has four ethylenic double bonds and three hydroxyl groups; it can be stored for extended periods of time.

In still another aspect, the invention is a method for producing a structural panel which comprises a layer of concrete and a layer of a thermoset, cellular urethane which is chemically and mechanically bonded to the concrete layer. The method consists essentially of placing a layer of a plastic concrete which contains cement, water and an aggregate, and is hardenable by hydration, in contact with a substantially planar mold surface so that it has an exposed surface which is generally opposed to the substantially planar mold surface, and causing a foamable isocyanate composition which is curable to a thermoset, cellular urethane to foam and cure to a thermoset condition while confined so that a portion of the composition is pressed against the surface of the concrete layer which is generally opposed to the substantially planar mold surface. In the foregoing description of one of the methods of the invention, the terms "placing" and "plastic" are used to have their usual meanings in the art (see, for example, *CONCRETE Basics,* a publication of the Portland Cement Association which is available on the internet at http://www.portcement.org/cb/concretebasics_concretebasics.asp).

THE PRIOR ART

US patent No.2,787,601, granted April 2, 1957 to Detrick et al., discloses the production of a cellular plastic material by reaction of an arylene diisocyanate with a fatty acid triglyceride, citing "German Plastics Practice," De Bell, Goggin and Gloor, 1946, pp. 316 and 463-465 as authority for the statement (column 1, second paragraph of the patent):

> "Cellular plastic products or plastic foams have been prepared in which isocyanates are used as one of the reactants * * *. In these products the cellular materials are prepared from alkyd resins which contain free carboxy groups."

The patent says that its cellular plastic product is prepared in two steps, a first in which a prepolymer is made by reacting a fatty acid triglyceride containing hydroxy groups with enough of a diisocyanate that, when not more than 47.5% of the total isocyanate groups in the diisocyanate have reacted with the hydroxy groups on the fatty acid radicals, there are no longer any remaining hydroxyl groups, and a second step in which the prepolymer is reacted with water and a tertiary amine catalyst. Upon addition of the water and the tertiary amine catalyst, the patent says, the

Fig. 34 is a perspective view showing a wall panel which is still another embodiment of the instant invention.

aluminum floor 19. The structural member 10 is also significantly superior to hardwood as a thermal insulating material, and can be made as thick as desired, within relatively wide limits, to provide the desired thermal insulating capability.

The liquefied 4,4'-DMI is commercially available from BASF under the trade designation Lupranate M20S. It contains 2.15 NCO groups per methylene group. A similar material is available from Mobay under the designation Mondur MR. Such materials can be produced by reacting 4,4'-MDI having a slightly higher ratio of NCO groups to methylene groups with a small amount of a polyethylene glycol having a molecular weight of about 400. The reaction lowers the NCO to methylene group ratio to 2.15, and produces a homogeneous solution, which is, essentially, a prepolymer.

The polymeric colorant used as described in Example 1 was one that includes a chromofor chemically bonded to an OH group, and is commercially available from Milliken Chemicals, Spartanburg, South Carolina under the trade designation REACTINT. The hydrogen of the OH group is active, so that it reacts with a free NCO group of the polymerizable composition, with the result that the colorant is chemically bonded to the cured material.

The static mixer used in the procedure described in Example 1 is commercially available from TAH Industries, Inc., under the trademark STATA-TUBE mixer. It is disclosed in U.S. patent No. 4,093,188. The same company markets another mixer under the trademark SPIRAL mixer, which is also suitable. This mixer is disclosed in U.S. patents No. 4,840,493 and No. 4,850,705.

An aluminum member having the shape of the floor 19, but made from thin sheet material, was used to produce a structural member similar to a part of the member 10. The specific member used was so thin that, when it was suspended between two supports which extended transversely of its channels, and were separated from one another by twelve inches, a load applied in the center of the member caused it to collapse before available instrumentation indicated the magnitude of the load. An identical aluminum member was then placed in the mold 14 (Fig. 1); the mold was charged with 568 g per 929 cm^2 of the intermediate/isocyanate composition produced as described above with reference to Fig. 1; a sheet of thin polyethylene was placed over the foamable composition; a sheet of expanded polystyrene was placed in the mold, above the polyethylene sheet; and the lid 17 was closed, and clamped shut. The composition expanded to fill the available space inside the mold 14, and cured to such an extent that it could be removed from the mold after about 10 minutes. After the foamed composition had cured for about 48 hours, the member, when it was suspended between two supports which were circular in cross

155, which was set to deliver the MDI at a rate of 44.6 parts per minute and the intermediate composition in the vessel 153 at a rate of 100 parts per minute through a line 157 to a mixer 158 where they were rapidly and thoroughly mixed before being discharged through a line 159 into the shell 132. The MDI introduced into the line 159 contained substantially 1.05 NCO groups per OH group in the intermediate composition introduced into the line 159. A charge of 112 pounds of the mixture into the cement shell 132, when it has the dimensions set forth above, produces a core having an apparent density of 12 pounds per cubic foot.

Panels similar to that designated 124 in Fig. 29, except that the parallel major surfaces were composed of 19 gauge sheet metal have also been produced by supporting appropriately sized panels of the sheet metal against plywood backing, closing the spaces between the edges and the ends of the metal panels with plywood sheets faced with polyethylene, and introducing the composition which formed the cured urethane core into the space between the metal sheets. Such a panel, which is indicated generally at 160 in Fig. 34, has 19 gauge sheet metal skins 161 and 162, and a thermoset urethane core 163 chemically and mechanically bonded to the skins. The panels 160, which can be about one inch in thickness have been found to be highly useful in building construction

In another embodiment of the invention of Fig. 23, the bodies 106 of polymeric material in the side members can extend above the upper stop 103 and below the sill 104 a sufficient distance, and can be so sized that they constitute studs of a wall structure in which the window frames are installed.

It will be appreciated that various changes and modifications can be made from the embodiments of the instant invention that have been described above without departing from the spirit and scope thereof as defined in the attached claims. For instance, Example 1 can be repeated except that the mold 14 is charged with about 1040 g of the composition flowing from the line 28 per 929 cm^2 of aluminum floor surface, disregarding the area of the legs which extend vertically in Fig. 2 and the area of the horizontally extending surfaces which face downwardly in Fig. 2. A sheet of a polyethylene sheet can then be placed over the polyol/diisocyanate composition, and the lid 17 of the mold can be closed. The urethane then foams until it is compressed between the lid 17 and the aluminum floor. The final product being a load-bearing floor, roof or the like structure having opposed, substantially parallel major surfaces and a body of a thermoset foam disposed between the major surfaces, one of the opposed major surfaces being a surface of a metal sheet, and there being legs which are structurally integral with the metal sheet and extend into the thermoset foam toward

the opposed major surface, and the other of the major surfaces being a surface of the body of thermoset foam, the structure having been produced by confining the metal sheet, the legs and a quantity of a foamable, thermosetable composition which foams and cures to a thermoset condition

I claim:

7. (Amended) A structural panel which consists essentially of a body of a thermoset, cellular urethane, said body being substantially right rectangular parallelepipedal in shape, having opposed major surfaces, and a metal sheet surface layer chemically and mechanically bonded to at least one of the opposed major surfaces.

9. (Amended) A structural panel as claimed in claim 7 which includes a metal sheet surface layer [of another material] chemically and mechanically bonded to both of the opposed major surfaces.

24. (New) A method for producing a structural panel which comprises a layer of concrete and a layer of a thermoset, cellular urethane which is chemically and mechanically bonded to the concrete layer, said method consisting essentially of placing a layer of a plastic concrete which contains cement, water and an aggregate, and is hardenable by hydration, in contact with a substantially planar mold surface so that it has an exposed surface which is generally opposed to the substantially planar mold surface, and causing a foamable isocyanate composition which is curable to a thermoset, cellular urethane to foam and cure to a thermoset condition while confined so that a portion of the composition is pressed against the surface of concrete layer which is generally opposed to the substantially planar mold surface.

25. (New) A structural panel as claimed in claim 7 wherein said metal surface is contoured so that it forms first and second pluralities of parallel channels having substantially coplanar webs, the webs of said first and second pluralities of parallel channels being vertically offset from one another, each channel of said first plurality being adjacent a channel of said second plurality, and being open on one side of its web while each adjacent channel of said second plurality is open on the opposite side of its web, and a plurality of substantially parallel sidewalls, each of which has an edge which is structurally integral with an edge of one of the webs of said first plurality of channels and an opposed edge which is structurally integral with an edge of the web of an adjacent channel of said second plurality, strips of one of the major surfaces of said body of thermoset cellular urethane being chemically and mechanically bonded to the sides of the webs of said first plurality of channels opposite the integral sidewalls, and said body of thermoset cellular urethane having portions which extend into and fill, and are chemically and mechanically bonded to, each channel of said second plurality which is adjacent a channel of said first plurality that is chemically

and mechanically bonded to a strip of the major surface of said body of thermoset cellular urethane.

26. (New) A structural panel produced by the method claimed in claim 24, which panel comprises a layer of concrete and a layer of a thermoset, cellular urethane which is chemically and mechanically bonded to the concrete layer.

27. (New) A structural panel as claimed in claim 25 which additionally includes a second metal surface which is contoured so that it forms first and second pluralities of parallel, second surface channels having substantially coplanar webs, the webs of said first and second pluralities of parallel channels being vertically offset from one another, each channel of said first plurality being adjacent a channel of said second plurality, and being open on one side of its web while each adjacent channel of said second plurality is open on the opposite side of its web, and a plurality of substantially parallel sidewalls, each of which has an edge which is structurally integral with an edge of one of the webs of said first plurality of channels and an opposed edge which is structurally integral with an edge of the web of an adjacent channel of said second plurality, wherein strips of the second of the major surfaces of said body of thermoset cellular urethane are chemically and mechanically bonded to the sides of the webs of said first plurality of second surface channels opposite the integral sidewalls, and said body of thermoset cellular urethane having portions which extend into and fill, and are chemically and mechanically bonded to, each channel of said second plurality of second surface channels which is adjacent a channel of said first plurality that is chemically and mechanically bonded to a strip of the major surface of said body of thermoset cellular urethane.

28 (New) A structural panel as claimed in claim 27 wherein the first and second channels of said second metal surface extend transversely of the first and second channels of said metal surface.

29. (New) A structural panel as claimed in claim 28 wherein the first and second channels of said second metal surface extend substantially at right angles to the first and second channels of said metal surface.

30. (New) A structural panel as claimed in claim 7 wherein said metal sheet surface layer is generally planar, but is contoured so that there are plural linear discontinuities extending thereacross and there is a pair of closely adjacent, generally parallel legs extending across said surface layer at each discontinuity, one edge of each of said legs being integral with said surface layer on one side of each discontinuity, and the opposed edges of the legs of each of said pairs

being integral with one another, said legs extending into the thermoset, cellular urethane body, and the exterior surfaces of each of said pairs of legs being chemically and mechanically bonded to said thermoset urethane.

31. (New) A structural panel as claimed in claim 7 wherein there is a metal sheet surface layer chemically and mechanically bonded to each of the opposed major surfaces of said thermoset cellular urethane body, each of said metal sheet surface layers is generally planar, but is contoured so that there are plural linear discontinuities extending thereacross and there is a pair of closely adjacent, generally parallel legs extending across said surface layer at each discontinuity, one edge of each of said legs being integral with said surface layer on one side of each discontinuity, and the opposed edges of the legs of each of said pairs being integral with one another, said legs extending into the thermoset, cellular urethane body, and the exterior surfaces of each of said pairs of legs being chemically and mechanically bonded to said thermoset urethane.